Annals of Clinical and Analytical Medicine
Original Research

Evaluation of ocular biometric changes and disease activity in patients with acromegaly

Ocular biometric changes in acromegaly

Pınar Alarslan[1], Sinan Emre[2], Bilgin Özmen[3], Zeliha Hekimsoy[3]
[1] Department of Endocrine and Metabolic Diseases, Faculty of Medicine, University of Health Sciences, Izmir Tepecik Training and Research Hospital, Izmir
[2] Department of Ophthalmology, Faculty of Medicine, Batıgöz Eye Hospital, İzmir
[3] Department of Endocrinology and Metabolism, Faculty of Medicine, Manisa Celal Bayar University, Manisa, Turkey

Abstract
Aim: Acromegaly is a chronic systemic disorder due to the excessive secretion of growth hormone (GH) and insulin-like growth factor 1 (IGF-1), having well-known repercussions on many organ systems. Its consequences on the eyes and ocular structures have been less investigated. Thus, this study aims to assess ocular biometric changes of patients with acromegaly and evaluate the association of these changes with disease activity markers.
Materials and Methods: This is a retrospective study of 35 patients with acromegaly along with 25 age and sex-matched controls. Thorough ophthalmologic evaluation was performed, including measurements of CCT, IOP, CH, CRF, retinal thickness (OCT), and SE. Also, biochemical parameters, along with disease activity (GH and IGF-1 levels), were analyzed.
Results: Patients with acromegaly reported higher IOP, CCT, and retinal thickness values than controls which were significantly retarded in CH and CRF. Increased prevalence of visual field defects and lower SE values were also noted in the acromegaly group. These results imply that chronic exposure to elevated levels of GH and IGF-1 may influence ocular structures, both anterior and posterior.
Discussion: The research shows that there are important differences in ocular biometric measurements in acromegaly patients that may indicate active phases of the disease. Implementing regular ophthalmologic evaluation as part of the comprehensive treatment approach can aid in identifying complications in patients, thereby optimizing their health outcomes.

Keywords
Acromegaly, Growth Hormone, Insulin-Like Growth Factor-1, Intraocular Pressure, Corneal Hysteresis

DOI: 10.4328/ACAM.22765 Received: 2025-06-03 Accepted: 2025-07-08 Published Online: 2025-07-31 Printed: 2025-08-01 Ann Clin Anal Med 2025;16(8):586-591
Corresponding Author: Pınar Alarslan, Department of Endocrine and Metabolic Diseases, Faculty of Medicine, University of Health Sciences, Izmir Tepecik Training and Research Hospital, Izmir, Turkey.
E-mail: drpinaralarslan2024@gmail.com P: +90 505 271 46 05
Corresponding Author ORCID ID: https://orcid.org/0000-0003-1790-0796
Other Authors ORCID ID: Sinan Emre, https://orcid.org/0000-0002-9788-3895 · Zeliha Hekimsoy, https://orcid.org/0000-0002-6003-0485
This study was approved by the Clinical Research Ethics Committee of Celal Bayar University (Date: 2009-03-15, No: 2009/003)

Introduction

Acromegaly is a chronic endocrine disorder with systemic effects, characterized by elevated levels of growth hormone (GH) and insulin-like growth factor 1 (IGF-1), typically caused by somatotroph adenomas originating from the anterior pituitary. Excess GH and IGF-1 lead to soft tissue overgrowth, visceromegaly, metabolic alterations, and cardiovascular complications, thereby increasing disease-related morbidity and mortality [1-3]. These effects are not limited to internal organs but may also cause structural and functional alterations in ocular structures, particularly the retina and cornea [4-7]. GH has endocrine, autocrine, and paracrine effects, playing a role in eye development and homeostasis, and influencing parameters such as ocular size, corneal thickness, and intraocular pressure [4, 5, 8].

There are a limited number of studies in the literature examining the relationship between GH/IGF-1 levels and ophthalmologic parameters. In some animal models, GH mRNA expression and GH immunoreactivity have been detected in the retinal layer, suggesting a direct involvement of these hormones in ocular development [9]. Studies in patients with acromegaly have reported increased IGF-1 levels in subretinal fluid [10], increased central corneal thickness [7], and elevated intraocular pressure [6]. Moreover, there is evidence indicating a predisposition to glaucoma in the context of GH excess [11, 12]. Conversely, increased average ocular dimensions have been observed after treatment in patients with GH deficiency [12]. However, existing studies generally have small sample sizes and limited variables, and comprehensive analyses of ocular biometric data in relation to the GH–IGF–1 axis remain insufficient [7].

This study aimed to evaluate various ophthalmological parameters (such as central corneal thickness, axial length, intraocular pressure, and visual field) in individuals diagnosed with acromegaly and to investigate the relationship of these parameters with disease activity indicators, including GH and IGF-1 levels. These parameters were selected due to their known sensitivity to hormonal influences and their potential to reflect early subclinical changes in ocular structure. The goal was to elucidate in more detail the effects of systemic disease activity on ocular structures in acromegaly.

Given its systemic nature, acromegaly requires a multidisciplinary approach, and ocular findings may provide important contributions to diagnosis, follow-up, and early detection of complications. However, the insufficient investigation of associations between changes in ocular biometric structures and GH/IGF-1 levels in the existing literature results in a knowledge gap in this area. To the best of our knowledge, few studies have evaluated a comprehensive set of ocular biometric and functional parameters in relation to biochemical disease activity. This study seeks to demonstrate the diagnostic and prognostic value of ocular changes in acromegaly and provide new perspectives for the early diagnosis and management of eye diseases. By integrating corneal biomechanics, pachymetry, IOP, and retinal structure analyses, this research offers a more holistic evaluation compared to previous studies and aims to support the inclusion of ophthalmologic screening in routine endocrine assessment. Additionally, it is expected to offer original data that will contribute to the field of endocrine ophthalmology.

Materials and Methods

This retrospective study reviewed the medical records of 35 patients diagnosed with acromegaly who were followed in the Department of Endocrinology and Metabolism at Celal Bayar University Faculty of Medicine, evaluating the association between their ophthalmologic findings and disease activity.

Findings from acromegaly patients were compared with those of a control group formed from control cases included in the Celal Bayar University Scientific Research Project No. 2009-003. Of the acromegaly patients, 21 were female and 14 were male, with a mean age of 47.26±12.59 years (range: 20 to 70 years). Six patients were in postoperative remission without medical treatment, 25 were receiving long-acting somatostatin analogs after surgery, and four patients had not yet received any treatment.

Inclusion Criteria

- Individuals aged 18 years and older diagnosed with acromegaly.
- Patients were followed in the Department of Endocrinology and Metabolism at Celal Bayar University.
- Patients with complete medical records related to ocular biometric measurements and GH/IGF-1 levels.
- Patients who underwent a full ophthalmologic examination and measurements during the study period.
- For the control group: age- and sex-matched individuals without systemic diseases and with complete ophthalmologic data.

Exclusion Criteria

- Individuals under the age of 18.
- Individuals with a history of ocular trauma, eye surgery, or corneal pathology.
- Patients with glaucoma, retinal diseases, or other serious ocular conditions.
- Patients with missing GH and IGF-1 levels or other incomplete biochemical data.
- Cases with incomplete or inaccurate ophthalmologic examination findings.
- Individuals with pituitary disorders other than acromegaly.

Patients were considered in remission if IGF-1 levels were within age- and gender-appropriate reference ranges, random GH levels were below 2.5 ng/mL, and GH levels in the oral glucose tolerance test were suppressed below 1 ng/mL. Based on these remission criteria, 26 patients were found not to be in remission.

Biochemical Analysis

In our hospital, serum GH levels were measured using a chemiluminescent immunometric assay with the IMMULITE 2000 system (SIEMENS) and GRH kit (Gwynedd, UK), while serum IGF-1 levels were determined using an enzyme-labeled chemiluminescent immunometric assay with the same system and an IGF-1 kit (Gwynedd, UK). Serum glucose was measured using the hexokinase end-point method, total and HDL cholesterol by the cholesterol esterase method with the Beckman Coulter DXC analyzer and commercial kits (California, USA). LDL cholesterol levels were calculated using the

Friedewald formula.

Ophthalmological Evaluation

All ophthalmological evaluations of acromegaly and control group patients were performed by the same specialist. Autorefractometry was measured, and visual acuity was assessed using the Snellen chart and decimal system. Intraocular pressure was measured using a Goldmann applanation tonometer. Corneal hysteresis (CH) and corneal resistance factor (CRF) were evaluated with ORA. Retinal thickness was analyzed quantitatively using the OCT scan protocol. Central corneal thickness was measured with ultra-high frequency ultrasound pachymetry after the application of a local anesthetic, and the axial length and corneal thickness were evaluated using a non-contact optical biometry device.

Statistical Analysis

Statistical analyses were conducted using NCSS (Number Cruncher Statistical System) 2007 and PASS (Power Analysis and Sample Size) 2008 software (Utah, USA). While evaluating the study data, descriptive statistical methods (mean, standard deviation, median, frequency, and ratio) were used.

For intergroup comparisons, the Student's t-test was used for normally distributed parameters, and the Mann-Whitney U test was used for non-normally distributed ones. Pearson and Spearman's correlation analysis was used to assess relationships between parameters. For categorical variables, Chi-square, Yates corrected Chi-square, and Fisher's exact tests were applied. A p-value of <0.05 or <0.01 was considered statistically significant.

Ethical Approval

This study was approved by the Clinical Research Ethics Committee of Celal Bayar University (Date: 2009-03-15, No: 2009/003).

Results

In the current study, records of 35 patients diagnosed with acromegaly were evaluated, and these findings were analyzed concomitantly with a control group. The demographic features of the subjects in both groups are detailed in Table 1.

No statistically significant difference was found between the groups regarding gender, age, systolic and diastolic blood pressure ($p > 0.05$). Nevertheless, body mass index (BMI) was markedly greater in the acromegaly group ($p < 0.025$) (Table 1).

Table 1. Demographic characteristics of the acromegaly and control groups

		Groups		p
		Akromegali Patients (n=35)	Control Group (n=25)	
		n (%)	n (%)	
Gender	Male	14 (%40.0)	11 (%44.0)	0.965
	Female	21 (%60.0)	14 (%56.0)	
		Mean±SD	Mean±SD	
+Age (year)		47.26±12.59	42.36±8.16	0.073
+VKI (kg/m2)		29.22±4.37	26.66±4.08	0.025
+ Systolic Blood Pressure (mm/Hg)		111.16±15.05	105.40±13.38	0.132
+ Diastolic Blood Pressure (mm/Hg)		75.26±11.57	69.56±15.30	0.106

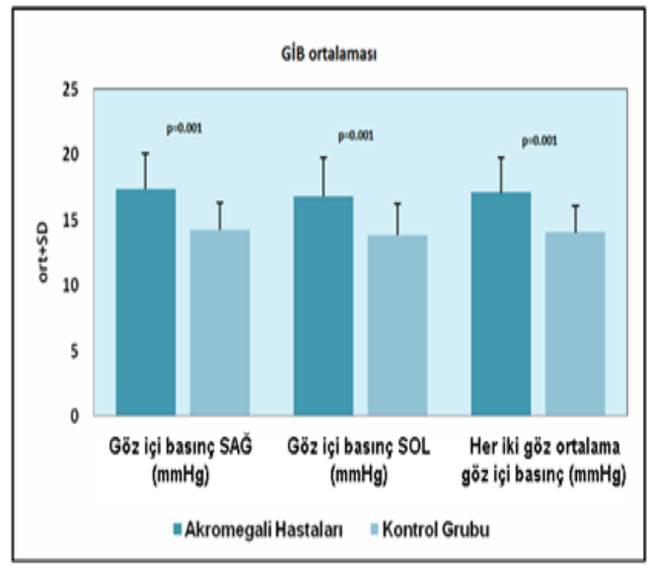

Figure 1. Mean intraocular pressure (IOP) by groups

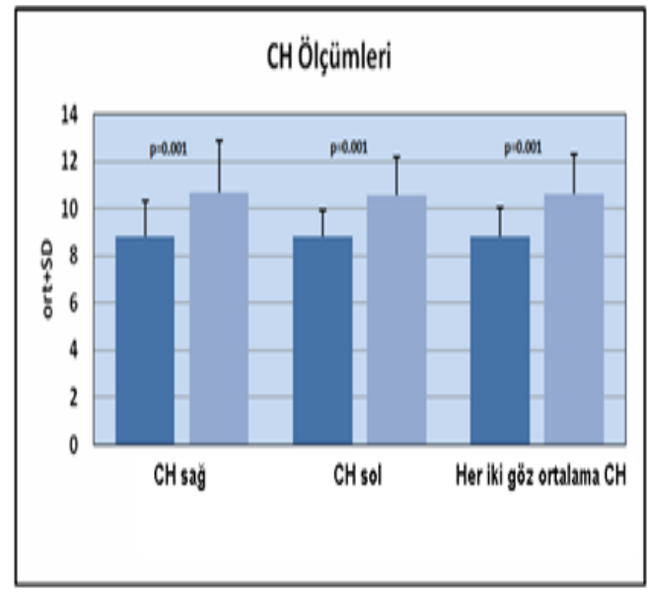

Figure 2. Corneal hysteresis (CH) measurements by groups

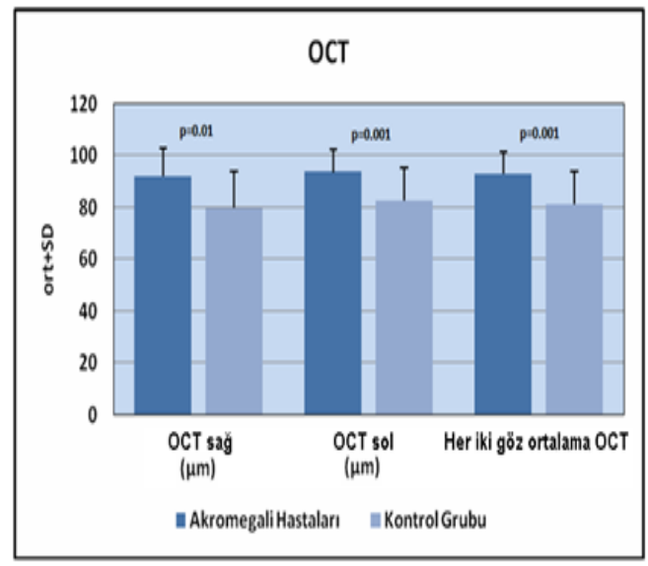

Figure 3. Optical coherence tomography (OCT) measurements by groups

Table 2. Frequency of comorbidities and mean biochemical parameters in the acromegaly and control groups

	Groups		p
	Akromegali Patients (n=35)	Control Group (n=25)	
	n (%)	n (%)	
Diabetes Mellitus	8 (%22.9)	0 (%0.0)	0.016
[a]Hypertension	10(%28.6)	2 (%8.0)	0.102
	Mean±SD	Mean±SD	
[b]Cholesterol (mg/dL)	173.80±44.50	162.93±40.26	0.336
[b]HDL cholesterol (mg/dL)	43.46±10.96	38.56±7.18	0.056
[b]LDL cholesterol (mg/dL)	106.20±28.85	78.88±17.51	0.001
[b]Fasting Blood Glucose (mg/dL)	98.20±11.28	83.44±10.79	0.001
Fisher's Exact Test	[a]Yates Test	[b]Student t Test	p<0.05

Table 3. Visual findings of acromegaly patients and controls

		Groups		p
		Akromegali Patients (n=35)	Control Group (n=25)	
		Mean±SD	Mean±SD	
[a]SE RIGHT; (Median) Diopter		0.10±0.52 (0.25)	0.32±0.37 (0.50)	0.048*
[a]SE LEFT; (Median) Diopter		0.16±0.42 (0.25)	0.28±0.36 (0.50)	0.111
Mean SE of Both Eyes; (Median)		0.13±0.41 (0.25)	0.30±0.35 (0.50)	0.032*
Visual Acuity RIGHT		0.96 ±0.13	0.92±0.12	0.277
Visual Acuity LEFT		0.91±0.16	0.95±0.09	0.252
Mean Visual Acuity		0.94±0.13	0.94±0.08	0.977
Intraocular Pressure RIGHT (mmHg)		17.37±2.69	14.24±2.07	0.001**
Intraocular Pressure LEFT (mmHg)		16.77±2.98	13.80±2.41	0.001**
Mean Intraocular Pressure (mmHg)		17.07±2.68	14.02±2.06	0.001**
Corneal Hysteresis (CH) RIGHT (mmHg)		8.85±1.45	10.69±2.17	0.001**
Corneal Hysteresis (CH) LEFT (mmHg)		8.85±1.07	10.53±1.62	0.001**
Mean CH of Both Eyes (mmHg)		8.85±1.16	10.61±1.67	0.001**
Corneal Resistance Factor (CRF) RIGHT (mmHg)		8.97±1.73	10.65±1.91	0.001**
Corneal Resistance Factor (CRF) LEFT (mmHg)		9.06±1.12	10.18±1.56	0.002**
Mean CRF of Both Eyes (mmHg)		9.00±1.34	10.41±1.62	0.001**
Optical Coherence Tomography (OCT) RIGHT (µm)		91.96±10.76	79.57±14.18	0.01**
OCT LEFT (µm)		93.64±8.71	82.66±12.71	0.001**
Mean OCT of Both Eyes (µm)		92.80±8.58	81.11±12.87	0.001**
Ultrasound Pachymetry RIGHT (µm)		547.91±35.55	524.64±26.45	0.008**
Ultrasound Pachymetry LEFT (µm)		548.34±39.83	532.24±32.27	0.101
Mean Ultrasound Pachymetry of Both Eyes (µm)		548.13±36.18	528.44±28.29	0.027*
Optical Pachymetry RIGHT (µm)		542.51±35.84	522.04±27.34	0.020*
Optical Pachymetry LEFT (µm)		544.20±35.29	527.24±29.76	0.055
Mean Optical Pachymetry of Both Eyes (µm)		543.36±35.41	524.54±27.56	0.031*
		n (%)	n (%)	
[b]Visual Field Defect	No	23 (%65.7)	25 (%100.0)	0.003**
	Yes	12 (%34.3)	0 (%0.0)	
Student T Test		[a]Mann Whitney U Test	[b]Yates Test	p<0.01

The proportion of patients with hypertension, average total cholesterol, and HDL cholesterol did not change significantly between the patient and control groups. However, the portion of patients with diabetes mellitus (DM), average levels of LDL cholesterol, and fasting blood glucose were markedly elevated in the acromegaly group ($p < 0.05$) (Table 2).

Table 3 illustrates the ophthalmological data of acromegaly patients and controls. Right eye and mean SE values for both eyes were significantly lower in acromegaly patients as compared to controls ($p = 0.048$ and $p = 0.032$, respectively). However, the left eye values remained similar. No statistically significant differences were observed in the visual acuity of the eyes between the groups ($p > 0.05$).

Significant differences were found between the acetabulum patients and the controls for the right eye, left eye, and averages of both eyes for intraocular pressure (IOP) measurements, as the values were significantly higher for the acetabulum patients ($p = 0.001$) (Figure 1).

Pachymetric measurements obtained by contact and non-contact ultrasonic and optical devices showed a marked increase in average readings among eyes of acetabulum patients compared to the control group ($p > 0.01$). Octopus visual field testing revealed scotoma (tangential defect) in 12 of the 35 acetabulum subjects (34.3%), which was not present in the control group ($p = 0.003$).

CH for the right eye, left eye, and both averaged for the acromegaly group were significantly lower than expected, which explains the value difference of ($p = 0.001$) (Figure 2). The same applies for corneal resistance factor (CRF) measurements, with marked differences between patients and controls ($p = 0.001$ and $p = 0.002$, respectively).

According to optic coherent tomography (OCT) results, the averages for the right eye, left eye, and both were significantly higher for the acromegaly group compared to the control group ($p < 0.01$) (Figure 3).

Significant differences were found between acetabulum patients and the controls for right eye, left eye, and averages of both eyes for intraocular pressure (IOP) measurements, as the values were significantly higher for chancre patients ($p = 0.001$).

Discussion

This study analyzed the ocular biometric parameters of patients suffering from acromegaly and evaluated their relationship with markers of disease activity such as GH and IGF-1. Significant differences between patients and healthy controls were noted with respect to central corneal thickness (CCT), intraocular pressure (IOP), corneal biomechanical properties (CH and CRF), and retinal thickness (OCT measurements).

Central to our observations are the elevated IOP values noted in acromegaly patients, which are greater than those of the controls. This is in agreement with earlier reports, which indicate that the excess production of GH and IGF-1 may augment the production of aqueous humor or diminish its outflow [13,14]. High IOP is said to be associated with heightened chances of glaucomatous optic neuropathy and has been noted in some studies as a predisposition risk factor for glaucoma in this population [2].

CCT values were higher in the acromegaly group compared to other groups. This aligns with earlier research by Batur et al., who also noted increased CCT in these patients [15]. Increased CCT may be a result of the profound remodeling that occurs

due to IGF-1 proliferative actions on keratocyte stroma stromal which are known to express IGF-1 receptors [16].

This study also showed reduced corneal hysteresis (CH) and corneal resistance factor (CRF) in patients with acromegaly, indicating changing corneal biomechanical properties. The literature describes reduced CH and CRF in patients with ocular hypertension and considers these characteristics indicators of corneal integrity and viscoelasticity. This may contribute to the evaluation of glaucoma risk in acromegalic patients and underlines the need for thorough ocular assessment [17].

In acromegaly patients, we noted higher retinal thickness values on OCT, indicating increased retinal volume. Recently, Erol et al. reported changes in the choroidal microvasculature of acromegaly patients using OCT angiography, suggesting that hormonal dysregulation may alter the retinal and choroidal architecture and their blood supply [14]. These results appear to support the impact of the GH/IGF-1 axis on the structures of the posterior segment, although more work with OCT angiography and dynamic imaging, such as ERG, is needed to understand the pathophysiology.

Despite refractive errors not being a primary outcome, SE values were lower in the acromegaly group, particularly in the right eye. Some studies have proposed increased axial length in acromegaly, presumably from GH-related somatic growth [18]. However, this parameter was not measured in the current study, which was not included in the present study, and deserves further attention.

Visual field testing showed scotomas in 34.3% of acromegaly patients, a finding that was absent in the control group. These data may indicate some degree of optic nerve or chiasmal compression even in treated patients, or long-standing microvascular compromise due to chronic disease.

Compared with recent literature, our study features a relatively comprehensive ophthalmologic evaluation, supporting recent claims like those of Batur et al. [13], Erol et al.[14] and their growing emphasis on the potential relationships between ocular alterations and biochemical activity of the disease, and attempts to fill this research gap. Most studies provided isolated parameters assessing acromegaly-related changes to the eyes; our study integrates corneal biomechanics and other parameters such as pachymetry, IOP measurements, and retinal scrutiny, advancing the understanding of eye involvement in acromegaly.

Limitation

The study has a few limitations regarding its design, including being retrospective and having a smaller sample size. As well, the omission of axial length measurements, along with hormone levels not correlating with imaging parameters in a quantitative model, remains a shortcoming. Regardless, the results validate the need for comprehensive eye examinations in acromegaly patients as part of multidisciplinary care, which is often overlooked. To confirm the findings and better understand the underlying mechanisms relating to the GH/IGF-1 axis and eye structures, more longitudinal prospective studies with larger patient groups should be conducted.

Conclusion

The research shows that patients with acromegaly have remarkable changes to certain eye measurement parameters, characterized by greater intraocular pressure, central corneal thickness, and retinal thickness, while also exhibiting diminished hysteresis and corneal resistance. These results indicate that enduring GH and IGF-1 elevation impacts ocular structures both in front of and at the back of the eye. Systematic eye checks in acromegaly patients can aid in the early identification of complications that pose a risk to vision and, therefore, should be considered in the holistic management of the condition.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or compareable ethical standards.

Funding: *None*

Conflict of Interest

The authors declare that there is no conflict of interest.

References

1. Ben-Shlomo A, Melmed S. Acromegaly. Endocrinol Metab Clin North Am. 2008;37(1):101–22.

2. Fleseriu M, Langlois F, Lim DST, Varlamov EV, Melmed S. Acromegaly: pathogenesis, diagnosis, and management. Lancet Diabetes Endocrinol. 2022;10(11):804-26.

3. Melmed S, Colao A, Barkan M, et al. Guidelines for acromegaly management: An update. J Clin Endocrinol Metab. 2009;94(5):1509–17.

4 . Harvey S, Baudet ML, Sanders EJ. Growth hormone and developmental ocular function: clinical and basic studies. Pediatr Endocrinol Rev. 2007;5(1):510–5.

5. Harvey S, Kakebeeke M, Murphy AE, Sanders EJ. Growth hormone in the nervous system: autocrine or paracrine roles in retinal function? Can J Physiol Pharmacol. 2003;81(4):371–84.

6. Kober AM, Sobol M. Intraocular pressure (IOP) in patients with acromegaly versus healthy controls: a systematic review and meta-analysis. Vision (Basel). 2024;8(3):54.

7. Ciresi A, Amato MC, Morreale D, Lodato G, Galluzzo A, Giordano C. Cornea in acromegalic patients as a possible target of growth hormone action. J Endocrinol Invest. 2011;34(2):30–5.

8. Skrzypiec I, Wierzbowska J, Sobol M, Zieliński G. Corneal tonometric and morphological changes in patients with acromegaly. J Clin Med. 2022;11(22):6750.

9. Bourla DH, Laron Z, Snir M, Lilos P, Weinberger D, Axer-Siegel R. Insulinlike growth factor I affects ocular development: a study of untreated and treated patients with Laron syndrome. Ophthalmology. 2006;113(7):1197.e1–5.

10. Zhang X, Ma J, Li L, et al. Elevated IGF-1 and GH levels are correlated with a thicker iris and wider anterior chamber angle in treatment-naïve acromegaly patients. Invest Ophthalmol Vis Sci. 2022;63(11):27.

11. Congdon NG, Broman AT, Bandeen-Roche K, Grover D, Quigley HA. Central corneal thickness and corneal hysteresis associated with glaucoma damage. Am J Ophthalmol. 2006;141(5):868–75.

12.. Shirke S, Faber SC, Hallem E, et al. Misexpression of IGF-I in the mouse lens expands the transitional zone and perturbs lens polarization. Mech Dev. 2001;101(1):167–74.

13. Batur M, Özer MD, Üçler R, Seven E, Tekin S, Ünal F. Corneal parameters, ocular biometers, and retinal and choroidal thickness in acromegaly patients. Photodiagnosis Photodyn Ther. 2023;44(1):103773.

14. Erol RS, Tiryaki S, Şen EÇ, et al. Alteration in choroidal microvasculature determined by optical coherence tomography angiography in patients with acromegaly. Photodiagnosis Photodyn Ther. 2021;36(1):102590.

15. Ross A, Banerjee S, Chowdhury A. Deducing health cues from biometric data. Comput Vis Image Underst. 2022;221(1):103438.

16. Wang W, Yang T, Huang Q. Quality of life in patients with acromegaly: a scoping review. Orphanet J Rare Dis. 2024;19(1):251.

17. Demarchis L, Chiloiro S, Giampietro A, et al. Cancer screening in patients with acromegaly: a plea for a personalized approach and international registries. Rev Endocr Metab Disord. 2025:1-14.(open Access)

18. Badawi NES, Fawzy A, Osman MH, Mohamed MI. Possible effects of growth hormone therapy on the eye. Med J Cairo Univ. 2019;87(1):2963-66.

How to cite this article:
Pınar Alarslan, Sinan Emre, Zeliha Hekimsoy. Evaluation of ocular biometric changes and disease activity in patients with acromegaly. *Ann Clin Anal Med 2025;16(8):586-591*

This study was approved by the Clinical Research Ethics Committee of Celal Bayar University (Date: 2009-03-15, No: 2009/003).